Activity Title: Simulating the Work of a Fisheries Biologist

Subject: biology/environmental science

Grade Level: 7-10

Average Learning Time
(2) 45 minute class periods

Lesson Summary (Overview/Purpose)
Students will simulate the work of a fishery biologist works in order to gain a better understanding of the knowledge necessary to manage a fish population

Overall Concept
Fish populations are a renewable resource that must be managed if they are to be kept healthy

Specific Key Concepts
- Management consists of obtaining information related to fish populations, age structure of a population, and catch data
- Fish management is an ongoing process that requires yearly data collection

Focus Questions
- What type of data do fisheries biologists collect?
- Why is it necessary to collect data on fish populations?
- How is fish age determined?
- What is catch data?

Objectives/Learning Goals
- Students will simulate trawling for fish
- Students will calculate the average amount of "fish" caught
- Students will practice estimating fish age using otolith
- Students will analyze catch data for trends
- Students will simulate the work of a fishery biologist

Common Misconceptions
- Younger students may think that anything that lives in the ocean is a fish
- All fish are the same

Materials
(6) small fish nets
(6) coffee cans with lids (1-pound size)
(6) Reusable plastic plates; one plate for each station
(1) pound bag of dried lentils
(1) pound bag dried red beans
(1) pound bag dried black beans
(1) pound bag white beans

(1) pound bag unbleached rice (should be dark enough to be distinguishable from white rice)
(3) pounds white rice
(6) 100 milliliter graduated cylinders
(6) 250 milliliter beakers

Technical Requirements
Student access to Internet; access to YouTube (or download video clip prior to lesson); projector

Teacher Preparation
1. Download images of organisms from Internet to teacher computer
2. Download NOAA Fishwatch Video to teacher computer
3. Photocopy student lab worksheet
4. Prepare the "trawling stations" as follows:
    a. Put a mix of beans and rice in each of the six containers to represent six different trawling stations. Be sure to vary the mixtures so that students understand that each station is different. You may want to include one station that contains no rockfish, another that has more salps than rockfish, etc.
    b. Label with containers "Station #1, Station #2, etc.
    c. Place a container, a plate, and a fish net at each station

Keywords:
fishery, abundance data, catch data, trawl net, otolith, fishery biologist

Pre-Assessment Strategy/Anticipatory Set
Ask students to define renewable resource and to give examples of renewable resources. Ask them what happens to renewable resources if we do not take care of them properly.

Lesson Procedure:
1. Show the NOAA Fishwatch Video (3:18 min.) available at http://www.youtube.com/watch?v=-ALnClkAPA4
2. Handout the student lab "Simulating the Work of a Fisheries Biologist"
3. Have students read over the Terms to Know, Introduction, Biology of Rockfish, and Scenario. Teachers can also choose to have students read these directions out loud, stopping to clarify any questions students may have
4. Optional: Using the projector and a computer, show students photos of images of rockfish, salps, squid, krill
5. Have students work in lab groups of 3 to 4 to conduct Lab Procedure Part 1. Have students will rotate from station to station until they have completed Table #2 in the lab.
6. Have students use a computer to conduct Procedures 2 and 3 (this could be done at home if necessary)
7. Have students complete the analysis questions
8. Review student answers to analysis questions in a large group setting, making sure to clarify any misconceptions that arise

Assessment and Evaluation:
Students will answer the analysis questions after completing all parts of the lab activity

Standards

National Science Education Standards

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem

Ocean Literacy Principles

Ocean Principe 6: The ocean and humans are inextricably interconnected

b. From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security

g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all

Ocean Principle 7: The ocean is largely unexplored.

b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes

State Science Standards

PA Ecology 4.1

4.1.10 Examine the effects of limiting factors on population dynamics
Describe how organisms become classified as threatened or endangered

4.3.7 Differentiate between renewable and nonrenewable resource
Explain the distribution and management of natural resources

Additional Resources:

NOAA Fish Watch: http://www.fishwatch.gov/

Rockfish photos http://www.afsc.noaa.gov/Rockfish-Game/rockfish_studyguide.htm#display

List of rockfish species: http://www.afsc.noaa.gov/groundfish/RockfishGuide/species_list.htm

Fish Assessment:
http://www.nmfs.noaa.gov/stories/2012/05/05_23_12stock_assessment_101_part1.html

Sustainable U.S. Seafood: A Journey from Sea to Market
http://www.nwfsc.noaa.gov/education/foreducators/seafood.cfm

Video: The ABCs of Stock Assessment
http://www.youtube.com/watch?v=3UbWMdpavUE#at=234

NOAA Otolith Age Reading Demonstration
http://www.afsc.noaa.gov/REFM/Age/interactive.htm

Rockfishes of the North Gulf Coast
http://www.akmarine.org/publications/North_Gulf_Coast_Rockfish_poster_AMCC.pdf

Author: Patty McGinnis

Creation Date: 2013

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Student Handout

Lab: Simulating the Work of a Fisheries Biologist

Terms to Know
Fishery: a fish species being harvested by people
Fishery Biologist: a person who studies fish
Abundance data: an estimate of the number of fish
Biology Data—information about fish population and fish growth
Catch Data: the amount of fish removed by fishing
Trawl Net: a net dragged through the water to catch fish
Otolith: fish ear bone

Introduction
Do you like to eat fish? If so, you are not alone. In 2009 Americans consumed a total of 4.8 billion pounds of seafood, or approximately 15.8 pounds of fish and shellfish per person! You might wonder how come we don't run out of fish. Fish can be considered a renewable resource because they replace themselves if they are managed properly. When a fishery (a fish species being harvested by people) is managed, rules are put into place that tells the fishermen how many fish they are allowed to catch. This is done so that the fish population can replace itself.
A fishery biologist is someone who helps make management decisions about the fish using data about the fish population. The information a fishery biologist uses to make management decisions include abundance data, biology data, and catch data. Today you will learn how to collect information to manage rockfish.

Biology of Rockfish:
The term "rockfish" actually refers to more than 70 different species. Rockfish, which are named for their appearance, have large heads and live on the ocean floor. They tend to be very long living. Scientists estimate that some species can live as long as 200 years! Rockfish are slow to mature; many species do not breed until they are 20 years old. Some common names of important rockfish species are Pacific ocean perch and yellowtail. In the grocery store, you might see rockfish sold under the name red snapper, rock cod, or black bass.

Scenario:
You are a fishery biologist who is in charge of managing the rockfish fishery off the California coast. Your job is to estimate the rockfish population. This is not an easy job because the ocean is very large and very deep, making it impossible to count all of the fish in it. One way to estimate rockfish populations is to use a large research ship and drag the net through deep water to collect samples of fish. This work is done each spring in order to capture juvenile (young) fish. Knowing how many juveniles are in the population give you an idea about the health of a population. Trawl nets bring up other animals besides fish. Often squid, krill, shrimp, and jelly-like zooplankton can be found in the trawling net. In the simulation, you will use dried beans and rice to represent the various organisms that might be found in a trawl net. Below is a key

Key

Organism	**Item**
Juvenile Rockfish	Black beans
Market Squid	Red beans
Gelatinous zooplankton (salps)	White Beans
Non-rockfish fish (anchovy, hake, pacific sanddab)	Lentils
Krill	White rice
Shrimp	Brown rice

Lab Procedure Part 1: Trawling for Juvenile Rockfish

1. Go to the first trawling station. Use the fish net to scoop items out of the container
2. Place the scoop on a paper plate for sorting
3. Separate all the "fish" and "squid" from the krill. Record their numbers in the table below
4. Do not count the krill individually. Instead, record the total VOLUME of the krill by pouring it into a 100-ml beaker or graduated cylinder. Record the amount
5. Return all the items back to the container
6. Repeat the same steps with the other containers locations (each container represents a different place in the ocean)
7. Calculate the average count for the rockfish, market squid, and other fish. Record in the data table
8. Calculate the average volume for the krill. Record in the data table

Table #2:

Species	Station #1	Station #2	Station #3	Station #4	Station #5	Station #6	Average
Rockfish							
Market Squid							
Other Types of Fish							
Shrimp							
Krill in ml							ml

Procedure Part 2: Aging Fish

Fish age is determined by counting the rings on a fishes' ***otolith***, or earbone. Ostoliths contain a ring for each year of growth. By counting the rings, fishery biologists can calculate fish age. Back in the lab, the fishery biologist determines the age of the fish caught during the trawls by counting the rings on the ostoliths. Try your hand at practicing with the NOAA Fisheries interactive aging program at http://www.afsc.noaa.gov/REFM/Age/interactive.htm. Age three fish of your choice and record your attempts in the table below. You may find it harder than it sounds!

Table # 3

Name of Fish	Your Estimate	Actual Fish Age

What are some of the challenges you encountered while aging the otoliths?

Procedure Part 3: Examining Catch Data
Catch information for commercial species of fish are found at:
http://www.st.nmfs.noaa.gov/pls/webpls/FT_HELP.SPECIES

Directions:

1. Go to the website written above.
2. Type in "Rockfish" in the species box
3. From the drop down menu select "Pacific Ocean Perch"
4. Select the "From" box and select 1950
5. Click on "Output Form" and select "Table"
6. Scroll down and click the "Submit Query" button
7. What is the population trend for the number of Pacific Ocean perch caught? Don't focus on individual years, but instead describe what is happening in general to the population over time. Is it increasing or decreasing? Record your answer in the data table below.
8. Repeat the same steps with the following rockfish species: Blackgill, Bocaccio, Yellowtail, and Widow.

Data Table 4:

Species	**Pacific Ocean Perch**	**Blackgill**	**Bocaccio**	**Yellowtail**	**Widow**
Population Trend					

Analysis Questions

1. Why is it important to collect data on fish species each year?
2. Why do you think the krill are recorded in millimeters instead of counted individually?
3. What are some factors that a fish biologist uses when determining the health of a fishery?
4. What other types of organisms live in the sea that can be found with fish?
5. How can the information you gathered be used to make recommendations to the fishing industry?
6. What will happen if we let people do too much fishing?
7. How do we know how many fish are in the ocean?
8. A scientist finds that the majority of fish being caught are too young to breed. How will this impact the population?

Enrichment/Extension Activity:
Fish populations were not always wisely managed, however. An example of a fish population that was not managed wisely is the Atlantic cod. At one time the Atlantic cod was one of the largest fisheries in the

world. Research “Tragedy of the Commons” and the Atlantic Cod fishery. How is the Atlantic cod fishery an example of tragedy of the commons?